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## ABSTRACT

Following up on earlier studies, the study reported in this paper further examined analogy as a source of interference to learning. Subjects, 103 undergraduate students randomly divided into three groups, studied a passage on Manichaeism with the aid of one of three forms of study guides: one having students generate comparisons between Manichaeism and Christianity, one having students generate contrasts, and one having students generate information about Manichaeism without reference to Christianity. Learning was measured with a free-recall test followed by a 20-item multiple choice test on Manichaeism. Results indicated that subjects who studied the text with a study guide requiring students to generate comparisons between the religions scored lower, recalled fewer correct facts, and gave significantly more incorrect information than students in the other two treatment groups. Findings lend support to earlier studies that found that analogies can enhance the effectiveness of study guides if the analogies do not compete with analogies in material to be learned. (One table of data is included; 23 references are attached.) (RS)

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Learning from Texts: Effects of Similar and Dissimilar  
Features of Analogies in Study Guides

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In this study we investigated questions arising from our research on learning from texts with the aid of study guides which are augmented with analogies. In our previous work, we have found that in general study guides appear to facilitate prose learning and that incorporating analogies in the study guides may add to their effectiveness. But we have also found that analogies in study guides are not always helpful, and may even interfere with learning. Our research indicates that learning from texts may be depressed if study guide analogies compete with analogies in the text from which students are expected to learn. Following up our work in this area, the study reported here further examined analogy as a source of interference to learning.

Background

In a survey of classroom teachers, Peterman, Dunning, and Tama (1989) found that 62% of respondents use study guides at least once a week, and that 91% use study guides as a basis for classroom discussion. The use of study guides to facilitate learning from texts has long been advocated

(Earle, 1969; Herber, 1970; McClain, 1981; Tutolo, 1977; Vacca, 1977), and many different types of guides have been proposed (Cunningham & Shablak, 1975; Davey, 1986; Olson & Longnion, 1982; Richgels & Hansen, 1984; Wood, 1988). By 1984, however, Tierney and Cunningham (p. 626) reported that empirical support for the use of study guides was sparse. More recent research (Wyatt & Hayes, 1990, 1991; Bean, Singer & Cowan, 1985; Hayes, 1988) does suggest support for study guides, though this research has focused on the efficacy of incorporating analogies in the guide material. The effectiveness of the study guides in these studies may have been due to the presence of analogies, which other research would strongly suggest (Alexander, 1988; Bean & Cowan, 1989; Gick & Holyoak, 1983; Hayes & Tierney, 1982; Simons, 1984; Vosniadou & Ortony, 1983; Vosniadou & Schommer, 1988).

To investigate the efficacy of study guides and to sort out the contribution of analogies to study guides' effectiveness, we (Wyatt & Hayes, 1990) conducted an experiment that compared study guides with and without analogies. In that experiment, undergraduate students studied three texts about obscure religions under three conditions: (1) without a study guide (control), (2) study guide without analogy, and (3) study guide with analogy. The analogical study guide had students draw parallels between the unfamiliar religion of the text to Christianity. We found that study guides did facilitate learning from texts and that analogies did contribute to their effectiveness.

However, we could not conclusively determine the contribution of analogies to the effectiveness of the study guides. One of the passages described a religion, Manichaeism, that was itself similar to Christianity, and scores were significantly lower among subjects using an analogical study guide to learn from that passage.

This result ran counter to the effects found for other passages. Comparing items of the test that could possibly have a Christian parallel with performance on other items of the test, we found no difference that would explain the interaction. We speculated that the analogies in the study guide may have caused conceptual confusion with the similarities to the analog in the passage, thereby depressing the total scores of readers who had used the analogical study guide. This possibility is consistent with an assertion advanced by Spiro and colleagues (1988) that analogies may sometimes mislead readers.

In a follow-up study (Wyatt & Hayes, 1991) we investigated the possibility that analogies in a study guide may interfere with learning if those analogies compete with analogies either set up independently by the learner or embedded in the material to be learned. We developed texts on three ancient civilizations: Egypt, Sumer, and Kemet, a civilization we invented to control for prior knowledge. The text on Kemet presented information similar to information in the text on Sumer, but dissimilar at many points to the information in the text on Egypt. To study these texts and

learn about Kemet, students used study guides that called either for comparing or for contrasting Kemet with Egypt and Sumer within identical categories. On a test on Kemet, students who had compared Kemet with Sumer recalled significantly less information than students who had contrasted Kemet with Egypt. These results are consistent with Ortony's (1979) notion that dissimilar features of metaphors are more effective than similar ones. And it provided support for our hypothesis about the initial experiment's interaction effect, that a study guide's analogies may restrict learning if they compete with analogies suggested in the material to be learned. As a more conclusive test of this hypothesis, we conducted an experiment that made use of the initial experiment's Manichaeism text.

#### Method

In the experiment, 103 undergraduate students were randomly divided into three groups to study the Manichaeism text, modified so that its analogies to Christianity were explicit. All materials were given to students in individual packets. No teaching was performed; subjects learned the material independently. Each group studied the text with the aid of one of three forms of study guides: one having students generate comparisons between the two religions, one having students generate contrasts, and one having students generate information about Manichaeism without reference to Christianity. Immediately after completing the study guide,

students computed 10 simple arithmetic problems as a buffer activity to control for short-term memory. Learning was measured with a free recall test followed by a 20-item multiple choice test on Manichaeism.

### Results and Discussion

Students' written recollections were inspected for individual facts about Manichaeism. Number of correct and incorrect facts were observed. Incorrect facts were further examined for their level of incorrectness, and for their association with analogies to Christianity embedded in the text. The multiple-choice test was the same test used in the first experiment. The recall and multiple-choice test data were subjected to one-way analyses of variance followed by comparison of conditions with t-tests. All p-values reported have been modified to control for multiple testing according to the Bonferroni method.

Test performance varied according to treatment condition on the multiple-choice measure ( $F_{2,101} = 3.85$ ,  $p = .024$ ,  $ES = .28$ ). As indicated in Table 1, scores of students who studied the text with a study guide that had students generate comparisons between Manichaeism and Christianity were significantly lower than either scores of students who studied the text with a study guide that had students generate contrasts between Manichaeism with Christianity ( $T_{68} = 3.652$ ,  $p = .001$ ) or students who studied the text with a study guide that did not refer to Christianity ( $T_{68} = 3.747$ ,  $p = .0008$ ).

Test performance also varied according to treatment condition on the free-recall measures. The ANOVA indicated a significant difference in number of correct facts recalled ( $F_{2,101} = 3.48$ ,  $p = .033$ ,  $ES = .26$ ). Students who used the study guide that made no reference to Christianity produced more correct information than students whose study guide had them generate comparisons to Christianity ( $T_{68} = 5.91$ ,  $p = .0002$ ) and students whose study guide had them generate contrasts to Christianity ( $T_{68} = 4.436$ ,  $p = .0002$ ).

The overall amount of incorrect information recalled did not differ significantly according to treatment condition. However, of particular importance to the investigation, we did observe a significant difference between treatment conditions in amount of incorrect information related to the analogy to Christianity in the text ( $F_{2, 101} = 16.66$ ,  $p = .0001$ ,  $ES = .57$ ). Students who generated comparisons between Manichaeism and Christianity gave significantly more incorrect information of this kind than students who generated contrasts ( $T_{68} = 3.71$ ,  $p = .0004$ ).



Table 1

Mean Performance on Tests of Learning from Passage

Test	Study Guide Type		
	Analogies Compare with Text Analogies	Analogies Contrast with Text Analogies	No Analogies
Multiple-Choice	14.11 (2.93) <sup>a</sup>	15.47 (1.87)	15.59 (2.48)
Free Recall			
Correct	12.22 (5.60)	13.12 (5.09)	15.59 (5.77)
Incorrect overall	1.17 (.97)	.82 (1.19)	1.27 (1.46)
Incorrect related to text analogies	1.00 (.83)	.29 (.76)	.12 (.33)

<sup>a</sup> Standard deviations are in parentheses

The data of this study add support to our explanation of analogies' apparent negative effect in one of the study guides of the initial experiment (Wyatt & Hayes, 1990) of our research on analogical study guides. That effect we explained as resulting from cognitive confusion arising from students' having to cope with competing analogies, the implicit analogies of the Manichaeism passage and the explicit analogies of the study guide. As analogies to Christianity in the study guide had depressed test performance on the Manichaeism passage in that experiment, so in the present experiment did the study guide that had students generate

comparisons between Christianity and Manichaeism. The results of the present experiment are consistent with the findings of our (Wyatt & Hayes, 1991) experiment in which students who compared the fictional civilization Kemet to the similar civilization Sumer did not perform as well on tests of learning about Kemet as did students who contrasted Kemet with the dissimilar civilization Egypt.

The results are important for teaching practice that makes use of study guides. Our earlier research showed that study guides can be effective instructional tools. The present research indicates that analogies can enhance the effectiveness of study guides if the analogies do not compete with analogies in material to be learned. If analogies of a study guide do compete with analogies of a text, students' performance may be depressed, and may be even worse for students than studying with a study guide without analogies. Additionally, focusing upon similarities between the analog and the target information can mislead students into believing that the analog and the target are more similar than is actually the case. Study guides that have students draw contrasting analogies between textual material and a familiar domain appear to be more effective. By emphasizing contrasting features between the analog and the target, students can be led to understand the differences between them.

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